

# THE WEATHER AND CIRCULATION OF AUGUST 1957<sup>1</sup>

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## 1. JULY-AUGUST PERSISTENCE

The summers of 1957 and 1956 were similar in that a sharp circulation reversal from June to July was followed by marked persistence from July to August at middle latitudes of the Western Hemisphere [1]. A high correlation was found between 700-mb. height anomalies of the latter pair of months for both years, as shown by the first line of table 1. In the area from 30° to 50° N. and 70° to 130° W. the correlation coefficients for both 1956 and 1957 far exceeded the .33 figure found by Namias [2] for the years 1942–1950.

Temperature anomalies over the United States in 1957 did not exhibit as great a degree of persistence as did 700-mb. height, principally because of the influence of high-latitude circulation changes (fig. 1). Cooling was extensive from July to August, lowering the temperature anomalies by one or more classes at 63 of 100 representative stations. Precipitation amounts were slightly less sensitive to remote circulation influences, changing class at only 57 of the 100 stations (table 1).

## 2. GENERAL CIRCULATION

Despite high July-August persistence in middle latitudes, several large 700-mb. height changes occurred at high latitudes. Figure 1 shows anomalous height falls of 300 ft. in the Arctic Basin, where an already intense July polar vortex [3] deepened to a remarkable mean value of 420 ft. below normal during August (fig. 2). Strong westerly winds (fig. 3) helped maintain a nearly complete circumpolar band of above normal 700-mb. heights south of the polar vortex, but with centers of action considerably displaced from July positions. Blocking in the Bering Sea and the Greenland-Iceland area was wiped out by falls in excess of 300 and 200 ft., respectively (fig. 1). Two changes of more than 300 ft. reversed the Canadian circulation pattern and produced an impressive couplet consisting of a blocking High in the Yukon and a strong Low in Hudson Strait (fig. 2).

A tendency toward high-latitude blocking over Siberia and western Canada was associated with southward displacement of the 700-mb. westerlies. Figure 3 illustrates the extent of this suppression since the 700-mb. mean jet stream (solid) was observed along or north of its normal August track (dashed) in only a small portion of the

TABLE 1.—Persistence measures of monthly mean anomalies in the United States from July to August

	1956	1957	1942-50
700-mb. height (lag correlation).....	0.76	0.80	0.33
Temperature (0 or 1 class change, percent).....	85	78	82
Precipitation (0 class change, percent).....	43	43	34

Northern Hemisphere (central Pacific and from James Bay to the British Isles).

In general, the mid-latitude circulation of the Western Hemisphere was typical of August, featuring mean troughs in the west-central Pacific and along both coasts of the United States and mean ridges in the eastern Pacific, continental United States, and central Atlantic. Only two of these systems were significantly stronger than normal; i. e., the east coast trough and the Atlantic ridge. Monthly mean 200-mb. systems (fig. 4) were essentially superimposed on their 700-mb. counterparts, except that the 200-mb. west wind maximum was somewhat farther to the south in the east coast trough (compare solid jet axes in figs. 3 and 4).

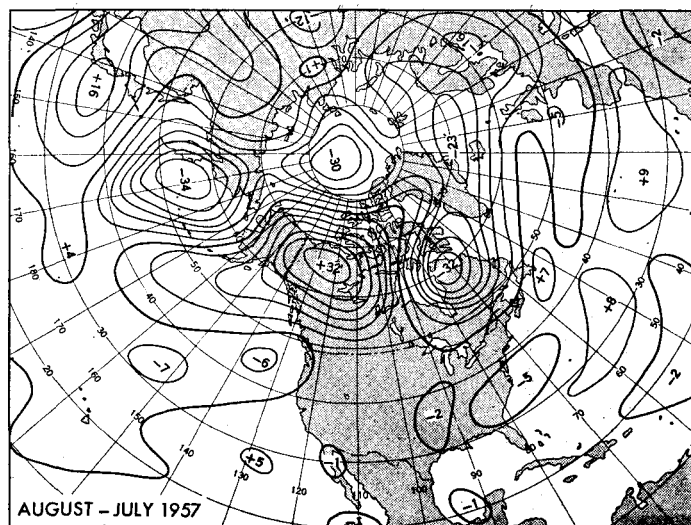


FIGURE 1.—Changes in monthly mean 700-mb. height departures from normal from July to August 1957. The lines of equal anomalous height change are drawn at 50-ft. intervals with the zero line heavier and the centers labeled in tens of feet. Large changes occurred in the polar regions, the Bering Sea, northwestern Canada, eastern Canada, and near Iceland. Small changes were predominant over the United States.

<sup>1</sup> See Charts I–XVII following p. 296 for analyzed climatological data for the month.

For the most part the location of the coastal troughs on 5-day mean maps during the month varied little from their mean monthly positions. A noteworthy exception was the temporary retrogression of the east coast trough which played a large part in late-month drought relief.

### 3. CIRCULATION AND UNITED STATES TEMPERATURE ANOMALIES

This month offers an interesting example of the way United States temperature anomalies are often affected by circulation features some distance away. Tempera-

ture anomalies in July and August 1957 may be compared in figure 5 for differences shown in table 1.

Cooling from the Great Lakes eastward can be associated with the effects of northerly DN flow on the monthly mean map (fig. 2), as described in a number of articles in this series (especially Hawkins [4]). Farther west the relation between cooling and circulation was less straightforward, since monthly mean 700-mb. heights continued above normal in the Northern Plains. However, figure 1 shows that large height rises in northwestern Canada combined with pronounced falls in eastern Canada to

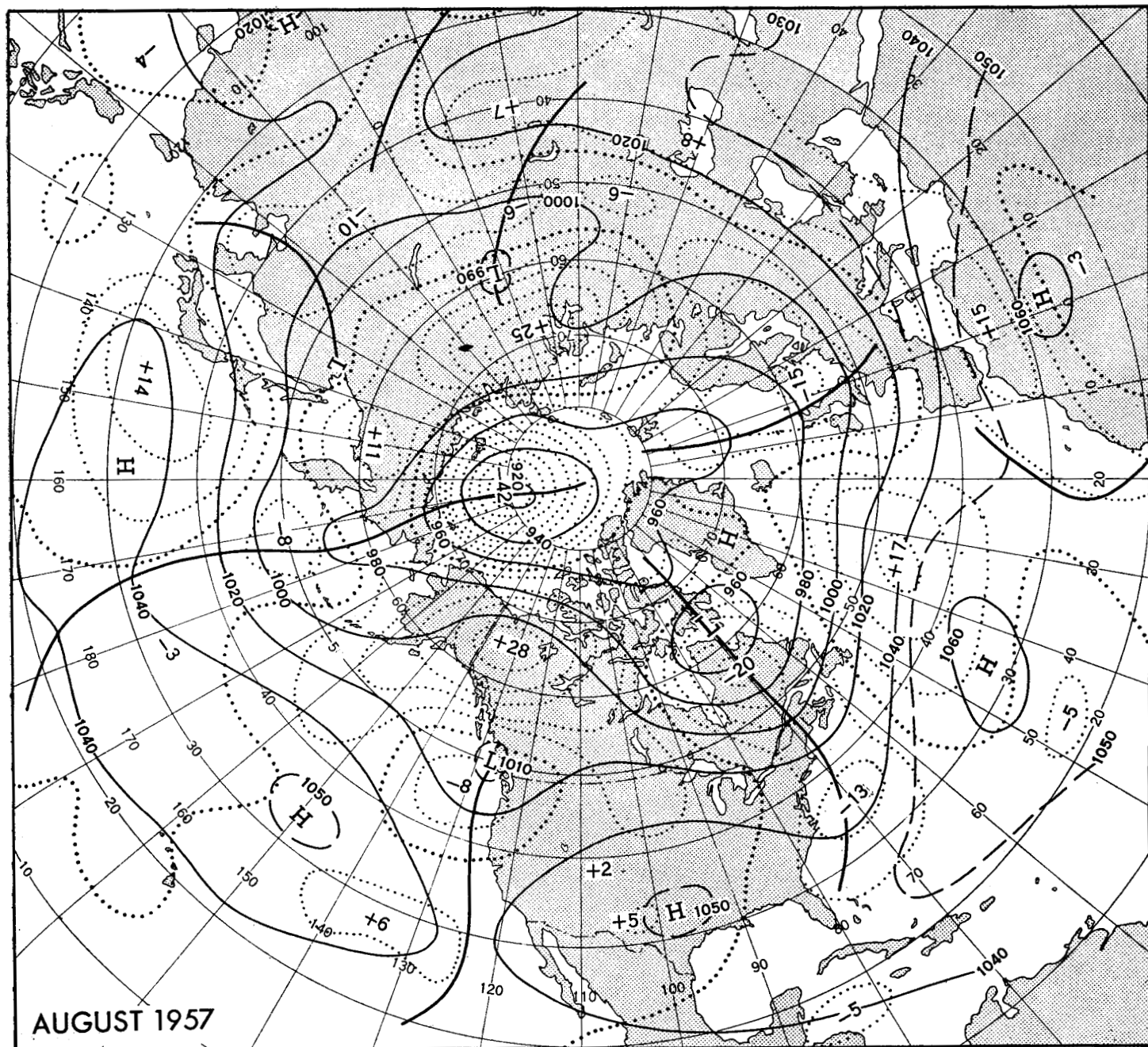


FIGURE 2.—Mean 700-mb. contours (solid) and height departures from monthly normal (dotted), both in tens of feet with troughs indicated by heavy lines, for August 1957. Important features include a blocking High over northwestern Canada, a warm High over Texas, and a deeper than normal mean trough in eastern North America.

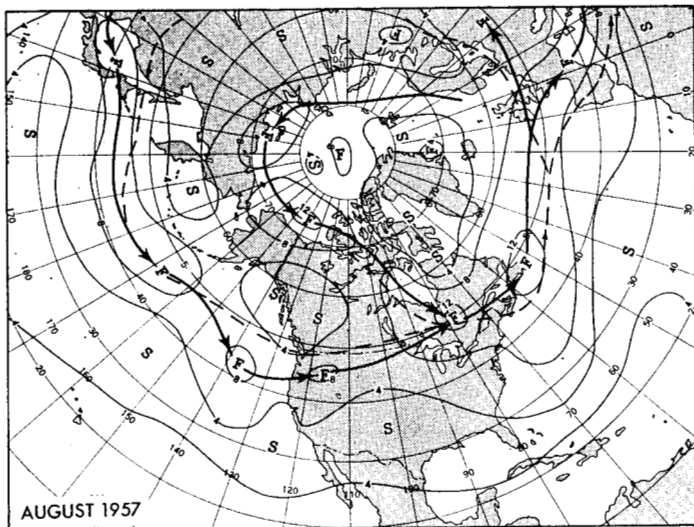


FIGURE 3.—Mean 700-mb. geostrophic wind speed (in meters per second) for August 1957. Solid arrows indicate major axes of mean 700-mb. jet stream and dashed arrows their normal August positions. The westerly jet was displaced south of its normal position in all portions of the hemisphere except the central Pacific and from James Bay to Ireland.

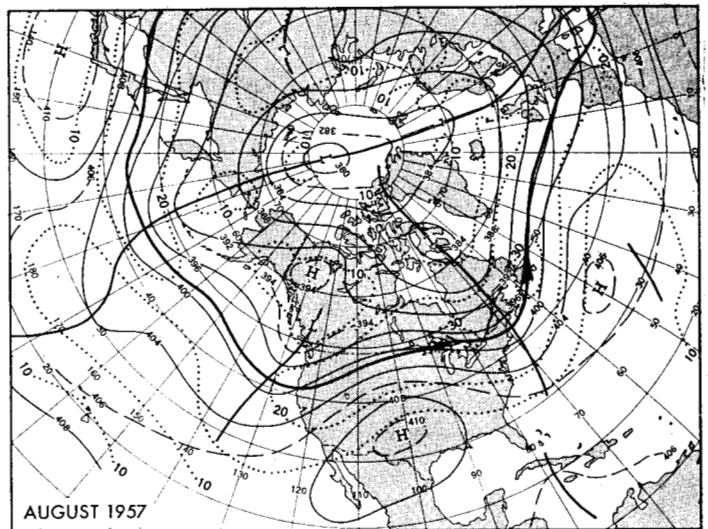


FIGURE 4.—Mean 200-mb. contours (solid, in hundreds of feet) and isotachs (dotted, in meters per second) for August 1957. Solid arrows indicate the position of the 200-mb. jet stream.

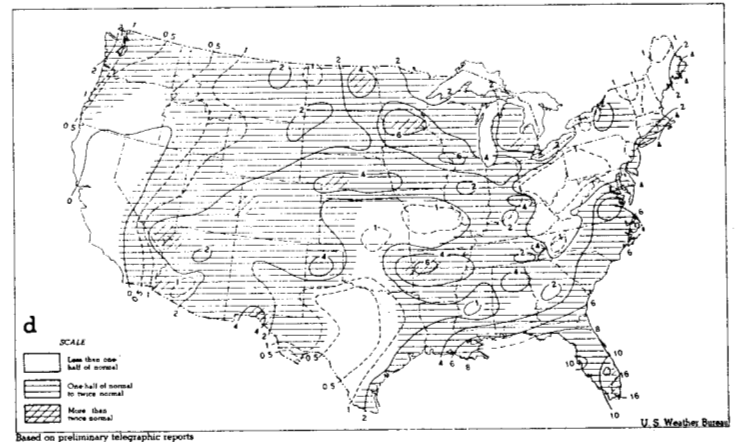
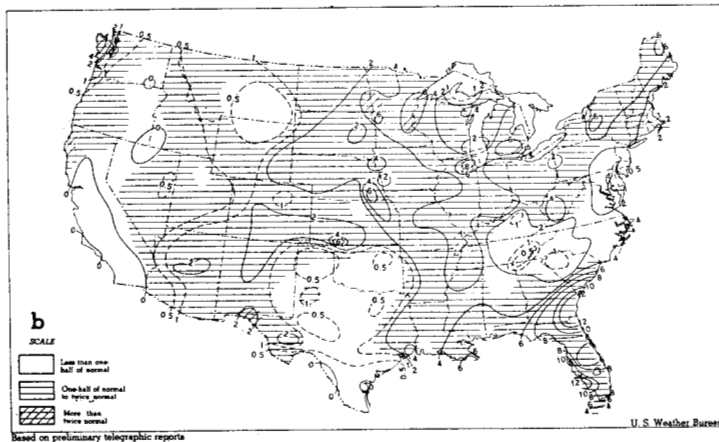
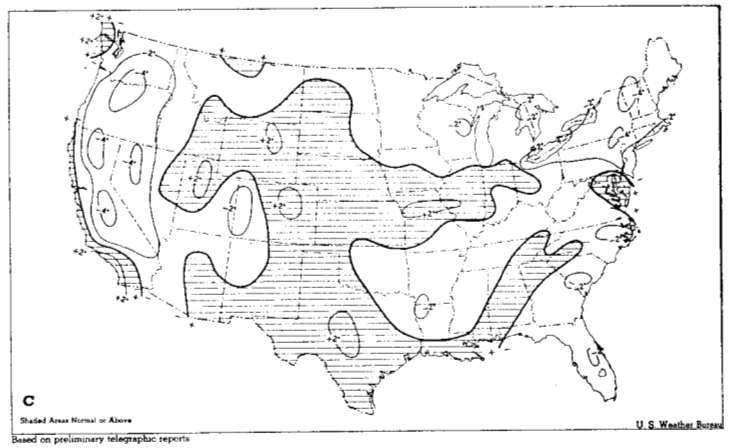
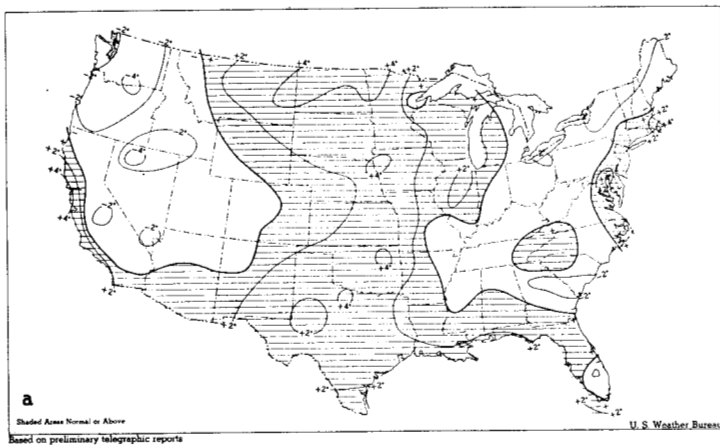


FIGURE 5.—Departure of average surface temperature from normal (°F.) and total precipitation (inches) for July 1957 and August 1957. (From *Weekly Weather and Crop Bulletin, National Summary*, vol. XLIV, No. 31, Aug. 5, 1957 and No. 35, Sept. 2, 1957.)

produce increased northerly flow components throughout central Canada. As a result cool polar air masses were transported across the northern border of the United States producing low temperatures in the northern Great Plains. One mechanism by which much of the cooling was accomplished is represented on Chart IX, giving the tracks of centers of anticyclones at sea level. A cool polar anticyclone moved into the Northern Plains of the United States from northwestern Canada early in the month, and others from southwestern Canada followed later, lowering temperatures from the Northern Plains across the Great Lakes to the Middle Atlantic States.

Cloudiness and precipitation accompanying migratory cyclones (Chart X) had a cooling effect in the Northern Plains, the Gulf States, and the Middle Atlantic States. Some infiltration of cool air as well as cloudiness and precipitation under the western moist tongue combined to cool western Nevada and Arizona and most of California. Southern California coastal temperatures were abnormally high however, with Los Angeles reporting the warmest August on record, Burbank and San Diego the second warmest. This is a common reaction to cool inland temperatures, and is generally attributed to a weakened sea breeze effect. In south-central United States mean temperatures remained 1° to 4° F. above normal under the nearly stationary upper-level High and generally anticyclonic circulation.

#### 4. PRECIPITATION

Eastern drought relief highlighted the precipitation picture in August, occurring mostly in the week ending the 26th. As reported in the *Weekly Weather and Crop Bulletin, National Summary* for that week (vol. XLIV, No. 34): "For the first time this season, steady soil-soaking rains, yielding about 1 to over 5 inches of moisture, fell on the area east of the Appalachians from Georgia to southern New England. Some stations reported the heaviest falls in nearly a year. . . ." Some relief had been provided in the preceding week in eastern Tennessee, North Carolina, and southern Virginia, but for the area northward to New England the first good rains were produced by a small storm travelling up the coast from the 25th to the 27th. This storm is discussed in considerable detail by Kibler and Rogers in an adjoining article [5]. The effectiveness of the storm as a rain-producer in the drought area was related to retrogression of the east coast 5-day mean trough (fig. 6) contributing to a northward trajectory quite different from that of the preceding wave which had moved eastward off the coast (see Chart X).

Earlier in the month an area of copious precipitation over eastern Oklahoma and Arkansas accompanied stalling remnants of tropical storm Bertha. Showers increased rainfall in a zone from southwestern Arizona through central Utah, a westward shift from July (cf. fig. 5b and 5d). In northern portions of the Rocky Mountain States, Great Plains, and Mississippi Valley, precipitation in-

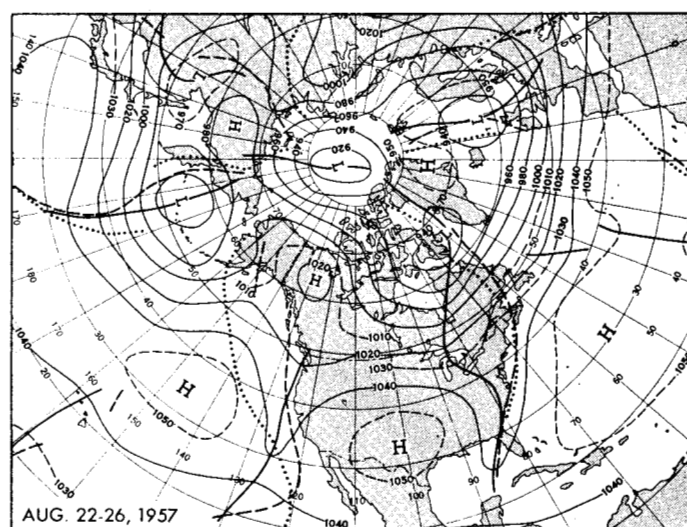


FIGURE 6.—Five-day mean 700-mb. contours (in tens of feet) for the period August 22-26, 1957. Solid vertical lines are mean trough positions. Positions of troughs for period August 20-24 are shown by dashed lines and for the period August 17-21 by dotted lines. Note sharp retrogression of east coast trough.

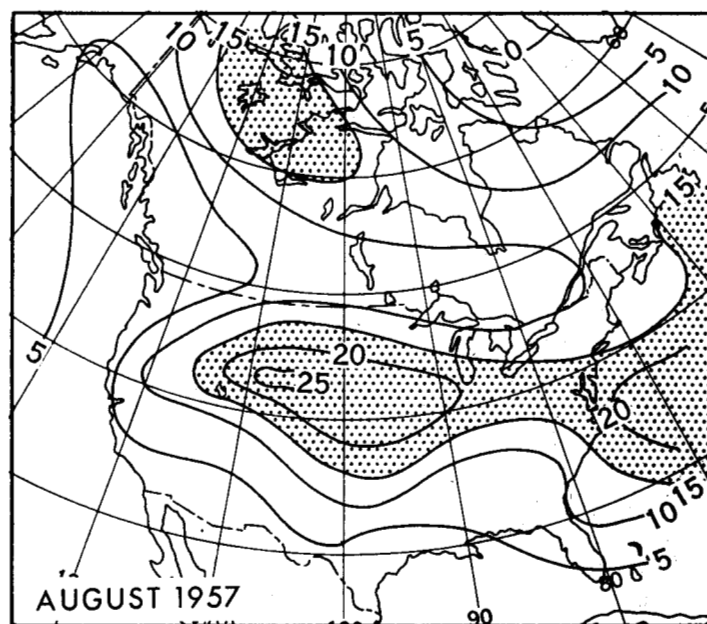


FIGURE 7.—Number of days in August 1957 with surface fronts of any type within squares with sides approximately 500 miles in length. Temperature anomalies were generally lower than in July north of the zone of maximum frontal activity.

creased with frequent cyclone activity (Chart X) and stalling fronts (fig. 7).

Abundant high pressure systems and few Lows helped account for the scant rainfall along the northern border from the western Great Lakes eastward and from Missouri through southern Illinois, Indiana, Ohio, and Pennsylvania. Dry weather continued in the Southern Plains near the center of the upper-level continental anticyclone.



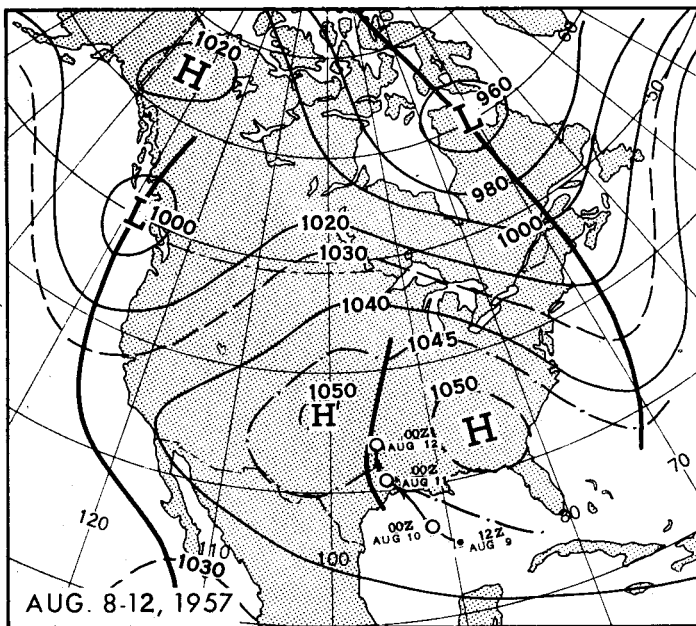
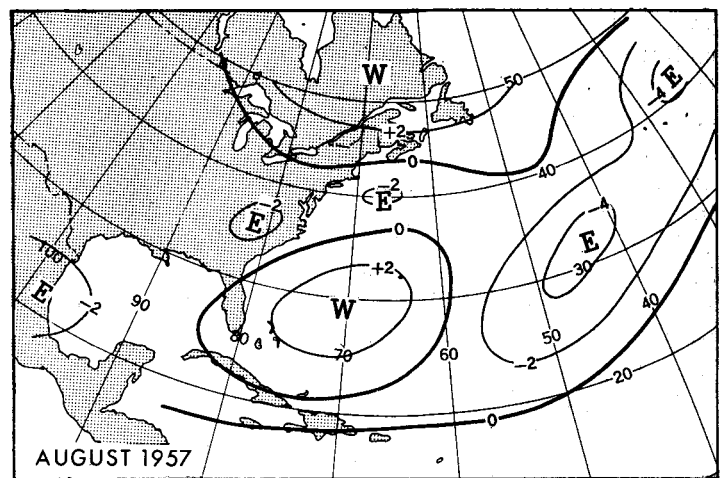


FIGURE 8.—Five-day mean 700-mb. map (in tens of feet) for the period August 8-12, 1957. Track of tropical storm Bertha is shown by arrows.

### 5. TROPICAL STORM ACTIVITY

Tropical storm Bertha was regarded with some trepidation upon its discovery August 8 near a position occupied in late June by devastating hurricane Audrey. Fortunately, however, Bertha was benign in comparison and, according to the results of final analysis by New Orleans Forecast Center, did not reach hurricane strength. The mean circulation attending Audrey, treated at length by Klein [6], was much different from that concomitant with Bertha. In place of a strong mean trough through the central United States as in June (fig. 4 of [6]), a strong High dominated the pattern for August (fig. 2). Respective 5-day mean patterns during the storms' histories (fig. 9 of [6] and fig. 8) essentially retained the monthly mean characteristics, so that the two storms developed and endured under very different circulation environments. Bertha apparently formed in an easterly break-off from a deep east coast mean trough in much the same manner as the small tropical storm of June 1956 [7].

A zonally-oriented ridge was located north of Bertha's path (fig. 8) subsequent to its formation, in sharp contrast to the deep mean trough along the path of Audrey [6]. The bridge of high pressure north of Bertha effectively shortened the storm's life and at the same time blocked almost all motion in the last few days of its deterioration over Arkansas. An interesting aspect of this stalling was the associated rain area, with higher totals (up to 8 inches) than any observed along the path of Audrey at similar latitudes. Audrey's absorption into a polar trough in the Mississippi Valley, however, did produce a storm with larger amounts of rain in Illinois and Indiana.

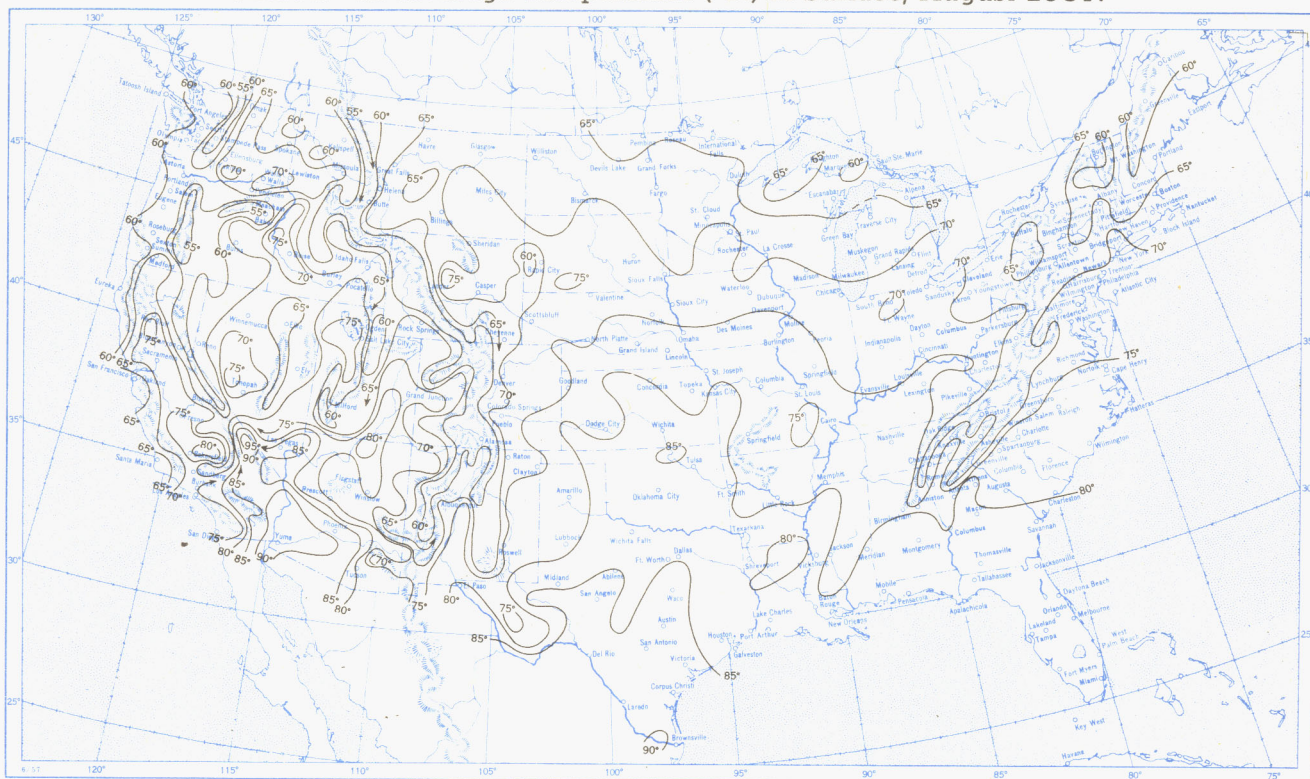
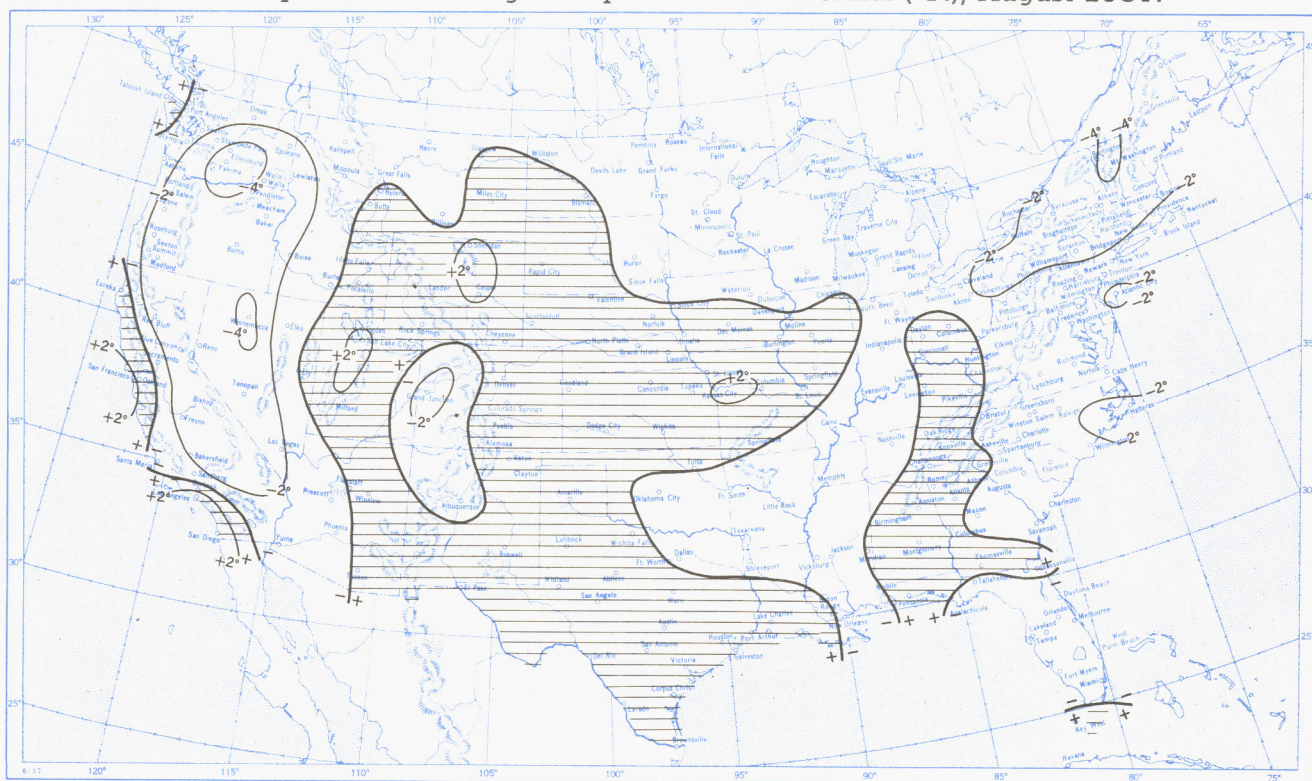


3. H. F. Hawkins, Jr., "The Weather and Circulation of July 1957—Drought in the East," *Monthly Weather Review*, vol. 85, No. 7, July 1957, pp. 254–258.
4. H. F. Hawkins, Jr., "The Weather and Circulation of October 1956—Including a Discussion of the Relationship of Mean 700-mb. Height Anomalies to Sea Level Flow," *Monthly Weather Review*, vol. 84, No. 10, October 1956, pp. 363–370.
5. C. E. Kibler and M. R. Rogers, "Drought Relieving Rains for Atlantic Coastal States, August 23–26, 1957," *Monthly Weather Review*, vol. 85, No. 8, August 1957, pp. 288–296.
6. W. H. Klein, "The Weather and Circulation of June 1957—Including an Analysis of Hurricane Audrey in Relation to the Mean Circulation," *Monthly Weather Review*, vol. 85, No. 6, June 1957, pp. 208–220.
7. R. A. Green, "The Weather and Circulation of June 1956—Another Hot June in Central United States," *Monthly Weather Review*, vol. 84, No. 6, June 1956, pp. 236–241.
8. J. Namias and C. R. Dunn, "The Weather and Circulation of August 1955—Including the Climatological Background for Hurricanes Connie and Diane," *Monthly Weather Review*, vol. 83, No. 8, August 1955, pp. 163–170.

## U. S. Weather Bureau Research Paper No. 40

Research Paper No. 40, "Principal Tracks and Mean Frequencies of Cyclones and Anticyclones in the Northern Hemisphere," by Wm. H. Klein, was recently issued. Charts are presented which summarize by months the frequency of and regions of genesis of cyclones and anticyclones. These charts and previous studies are used as a basis for deriving the principal tracks of cyclones and anticyclones. Additional statistics are presented and the synoptic climatology of cyclones and anticyclones is discussed.

This publication is available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is \$1.00 per copy.

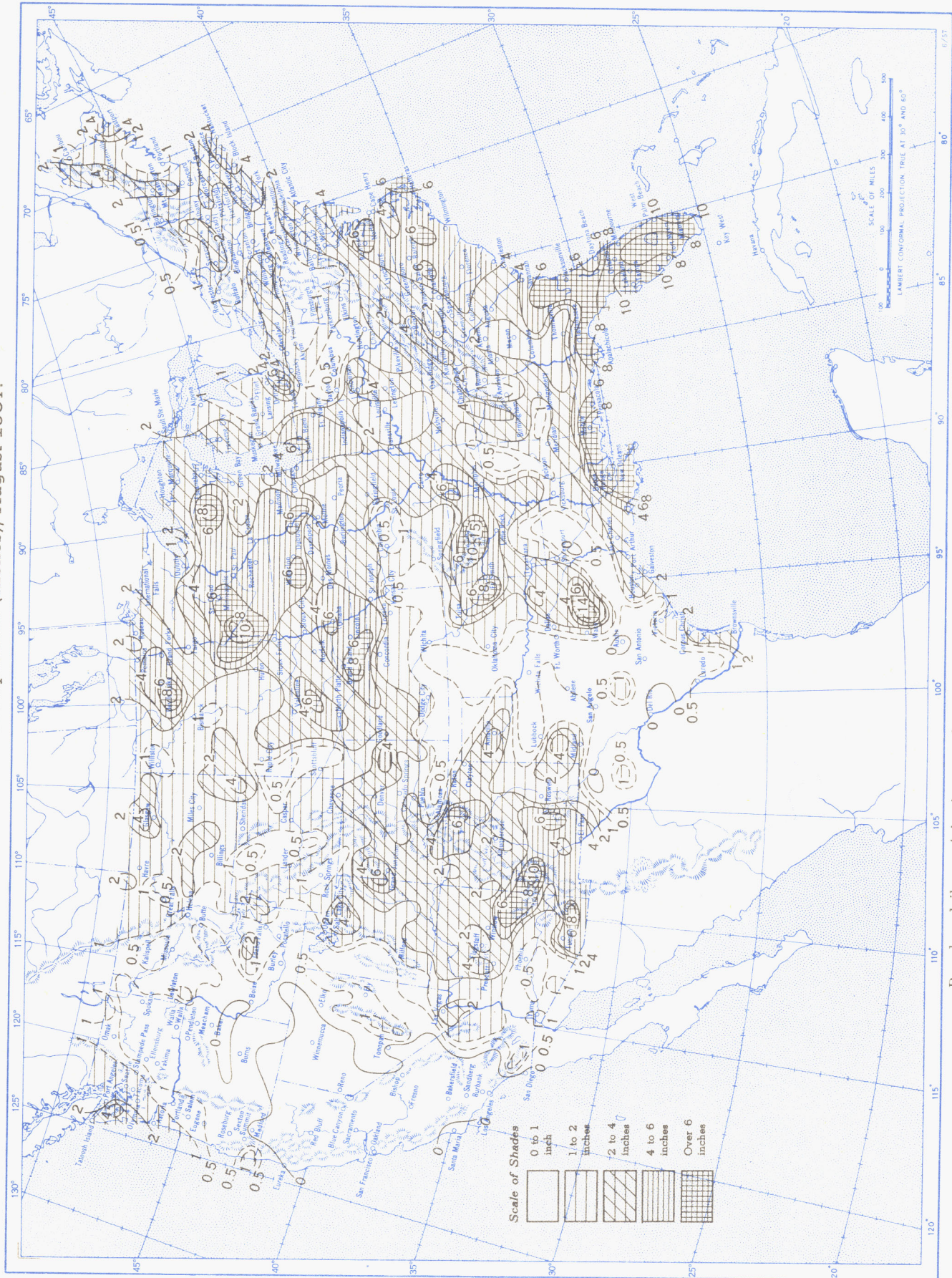
Chart I. A. Average Temperature ( $^{\circ}\text{F.}$ ) at Surface, August 1957.B. Departure of Average Temperature from Normal ( $^{\circ}\text{F.}$ ), August 1957.

A. Based on reports from over 900 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.

B. Departures from normal are based on the 30-yr. normals (1921-50) for Weather Bureau stations and on means of 25 years or more (mostly 1931-55) for cooperative stations.



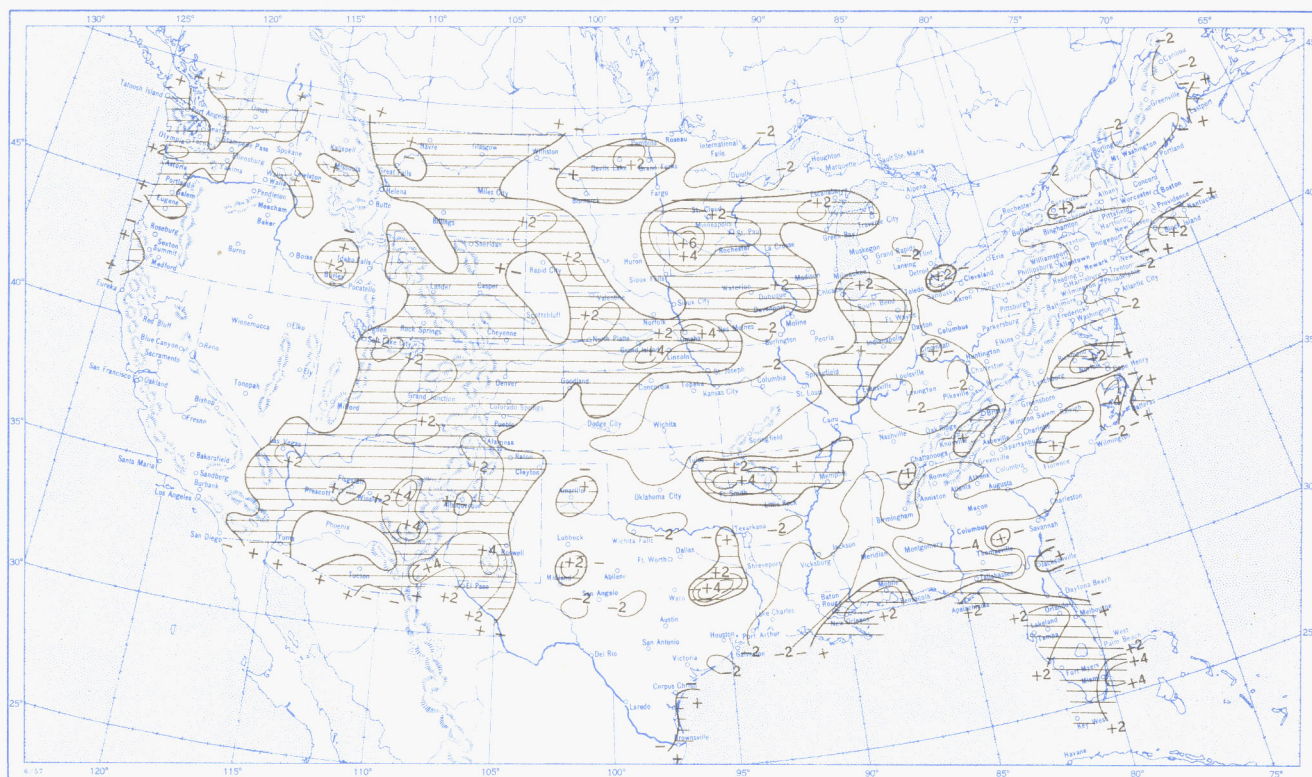
Chart II. Total Precipitation (Inches), August 1957.



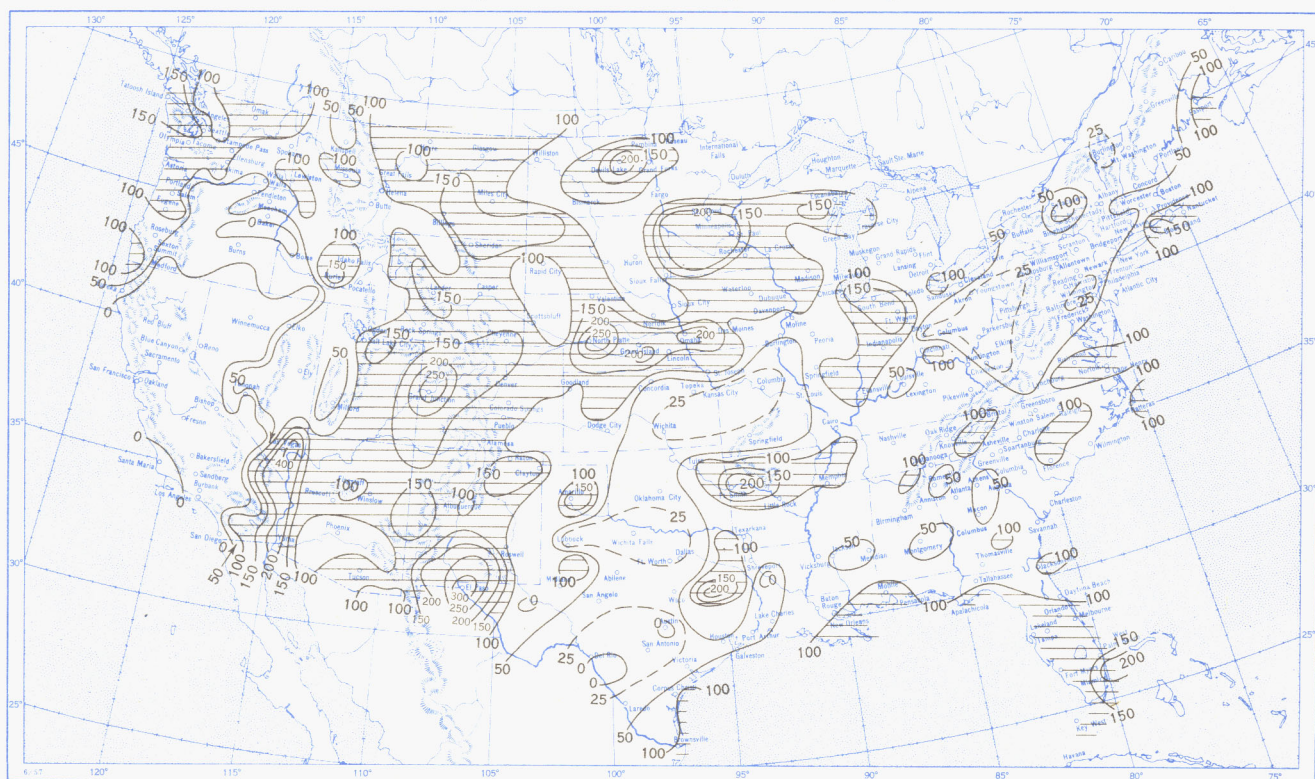
Based on daily precipitation records at about 800 Weather Bureau and cooperative stations.



Chart III. A. Departure of Precipitation from Normal (Inches), August 1957.



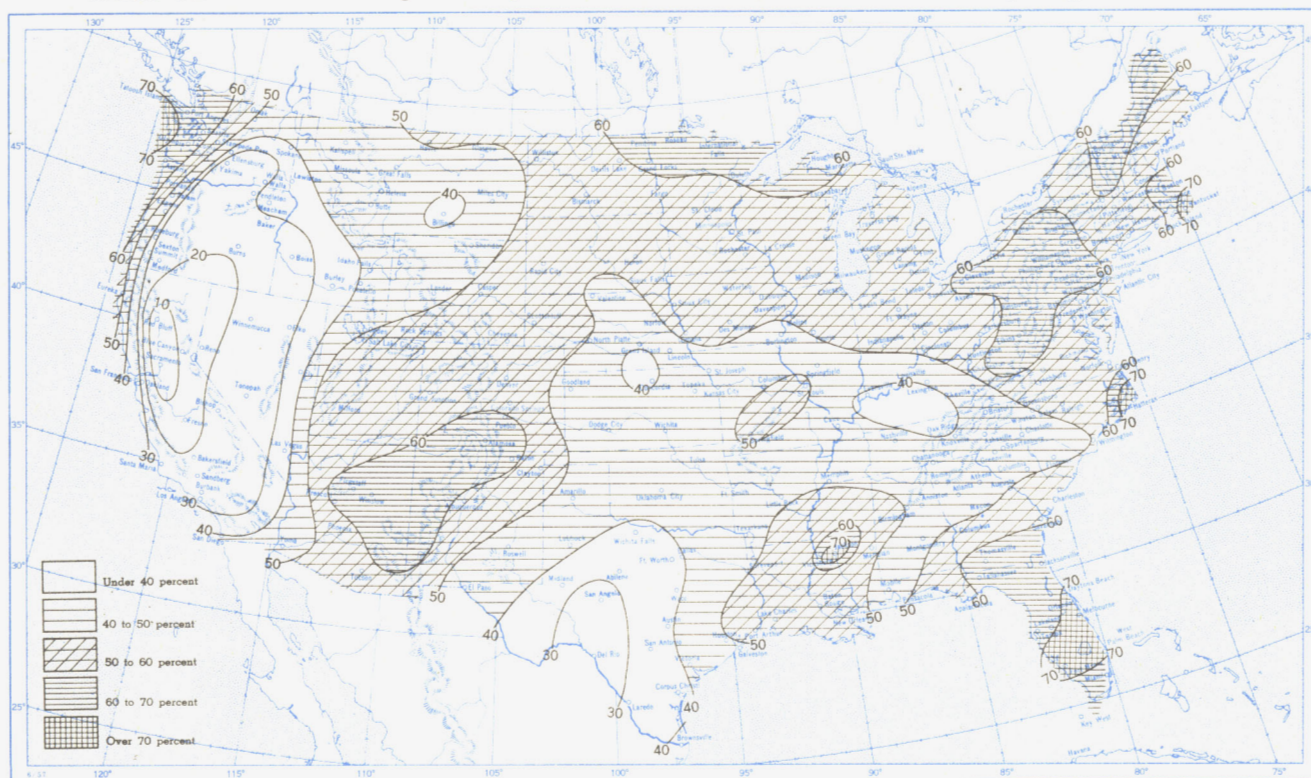
B. Percentage of Normal Precipitation, August 1957.



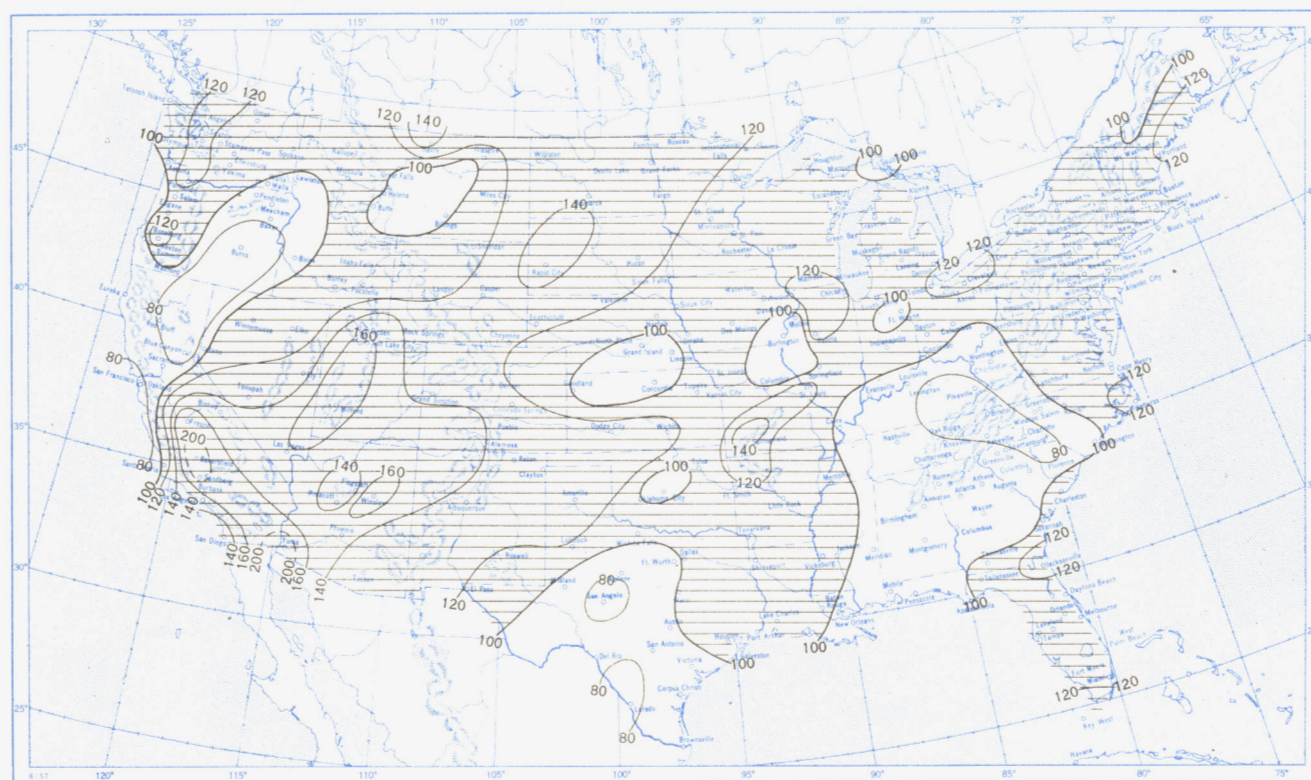
Normal monthly precipitation amounts are computed from the records for 1921-50 for Weather Bureau stations and from records of 25 years or more (mostly 1931-55) for cooperative stations.



Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, August 1957.



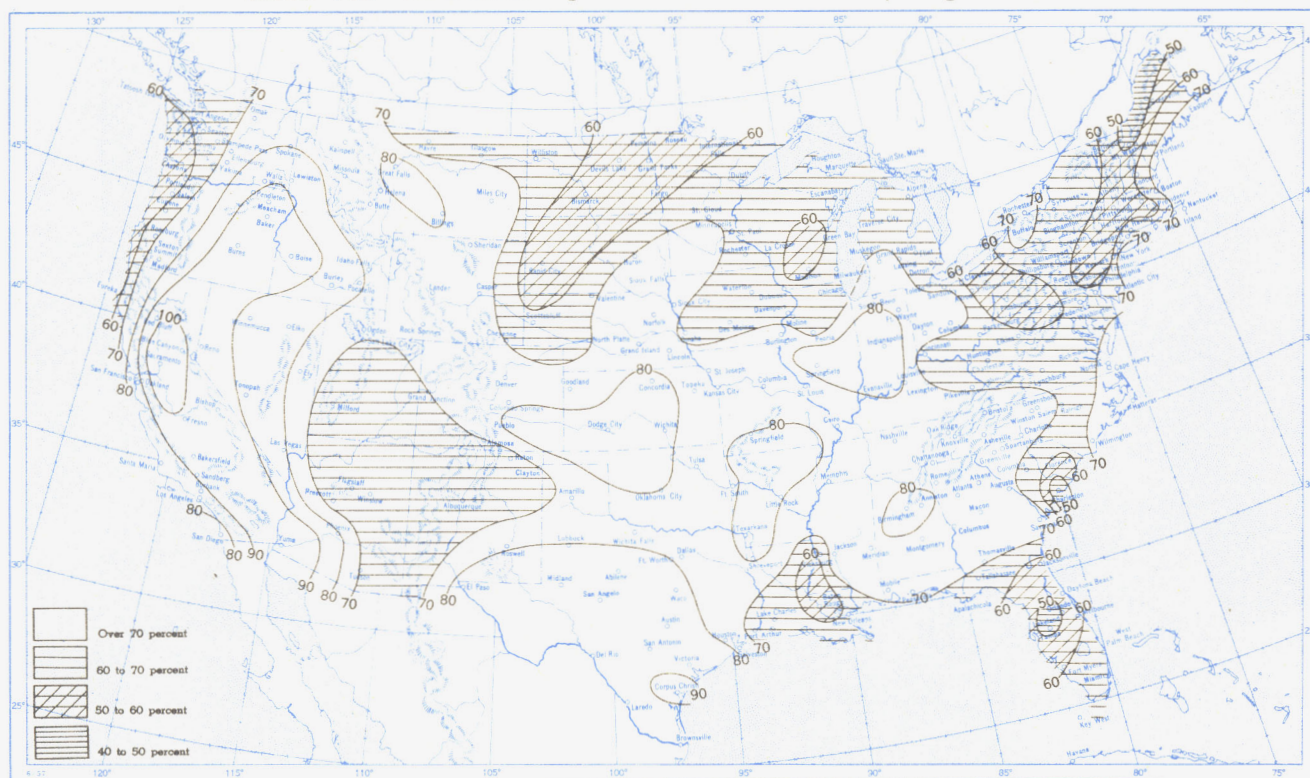
B. Percentage of Normal Sky Cover Between Sunrise and Sunset, August 1957.



A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.



Chart VII. A. Percentage of Possible Sunshine, August 1957.



B. Percentage of Normal Sunshine, August 1957.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.



Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, August 1957. Inset: Percentage of Mean Daily Solar Radiation, August 1957. (Mean based on period 1951-55.)

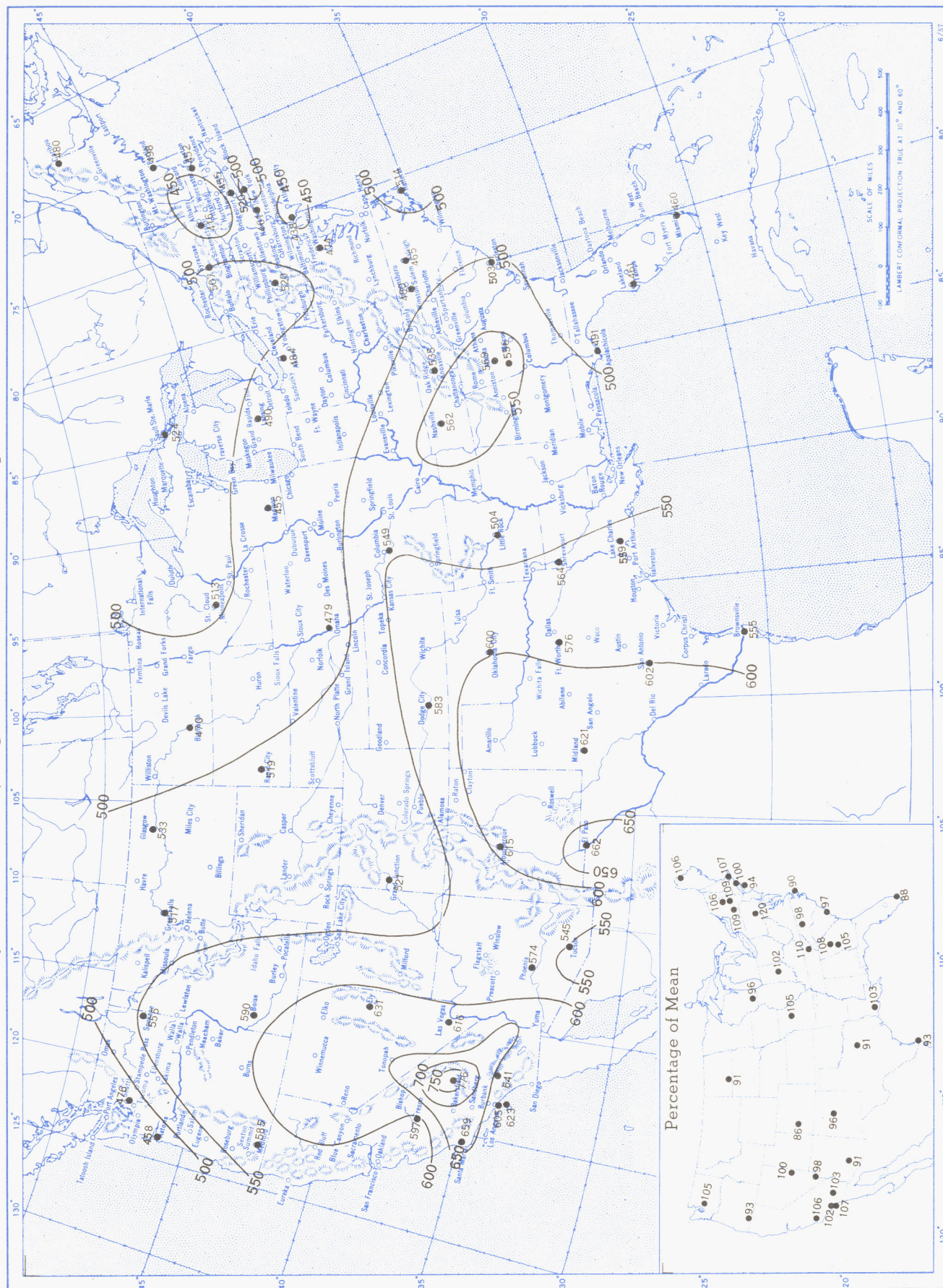


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. <sup>-2</sup>). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

The inset shows the percentage of the mean based on the period 1951-55.



Chart IX. Tracks of Centers of Anticyclones at Sea Level, August 1957.

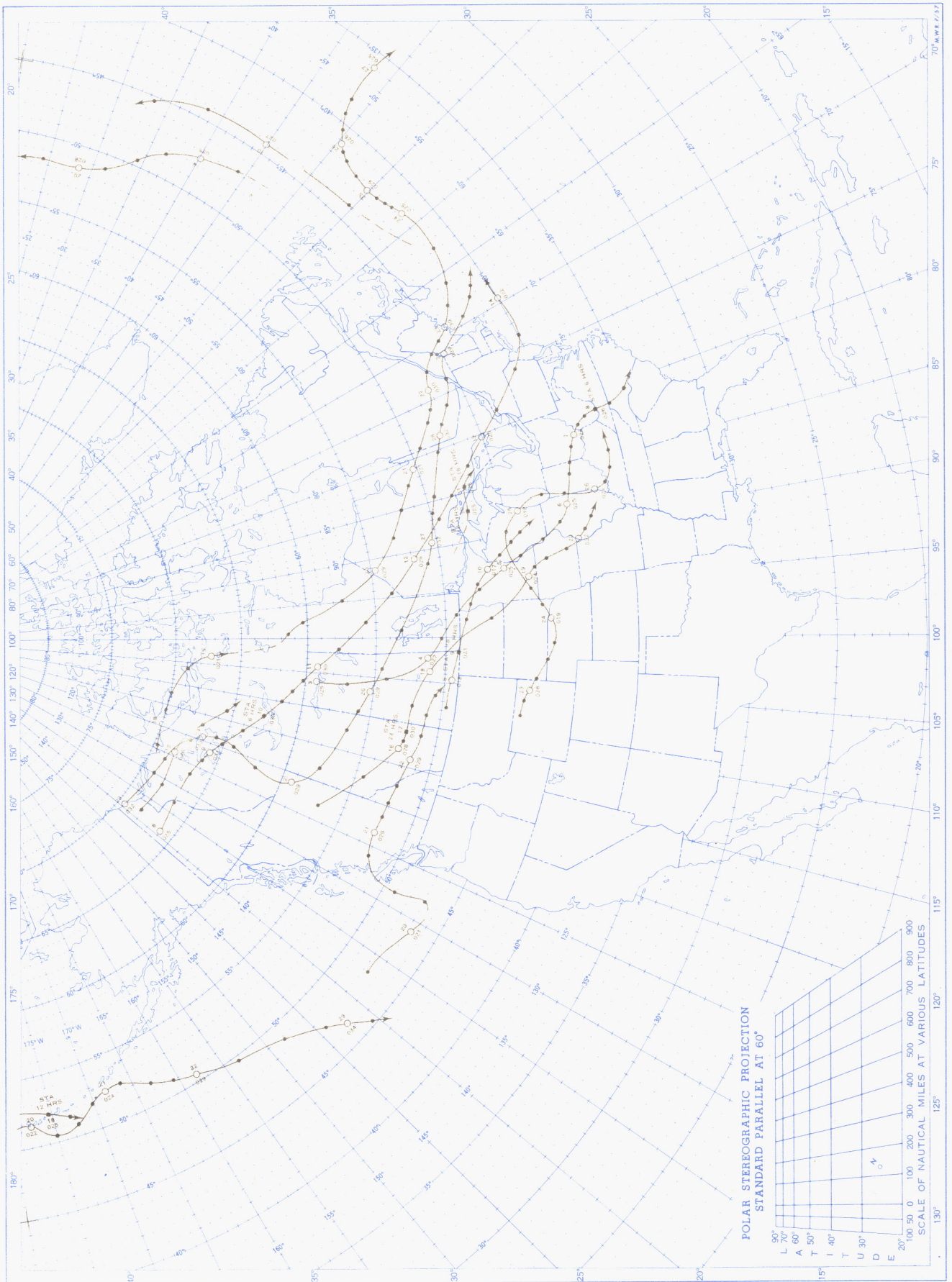
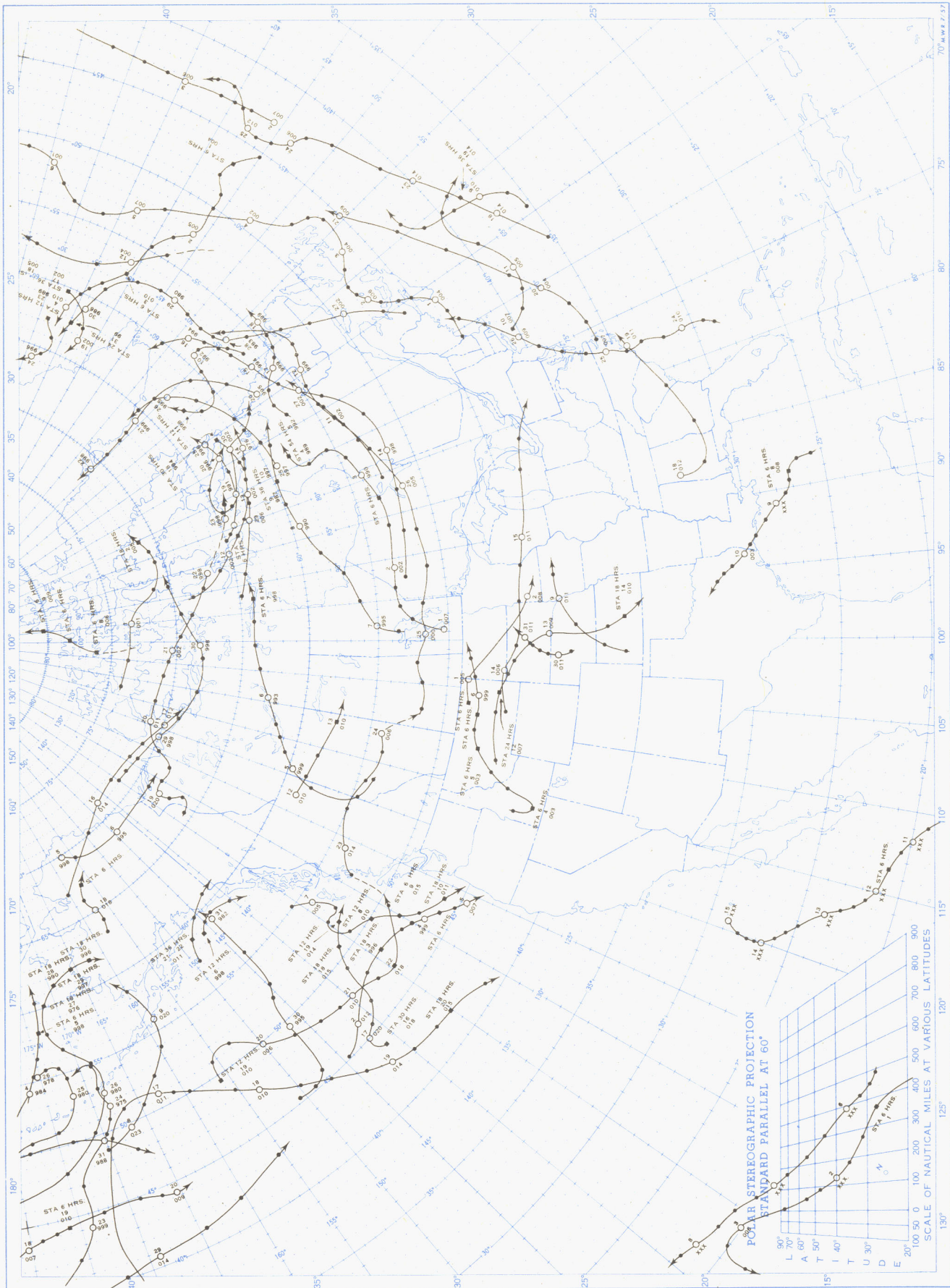




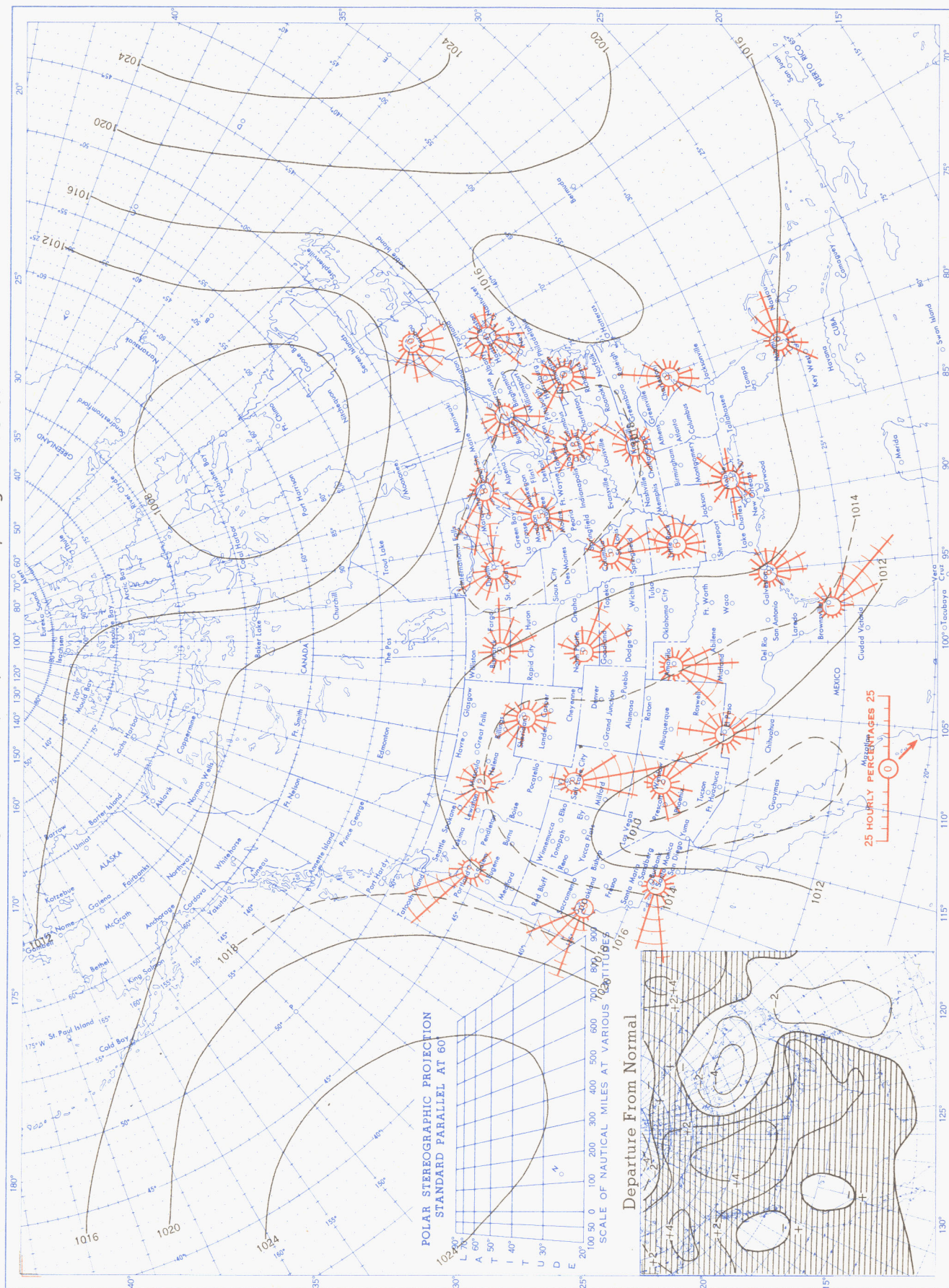
Chart X. Tracks of Centers of Cyclones at Sea Level, August 1957.



Circle indicates position of center at 7:00 a. m. E. S. T. See Chart IX for explanation of symbols.



Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, August 1957. Inset: Departure of Average Pressure (mb.) from Normal, August 1957.



Average sea level pressures are obtained from the averages of the 7:00 a. m. and 7:00 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° inter-sections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.



Chart XII. 850-mb. Surface, 1200 GMT, August 1957. Average Height and Temperature, and Resultant Winds.

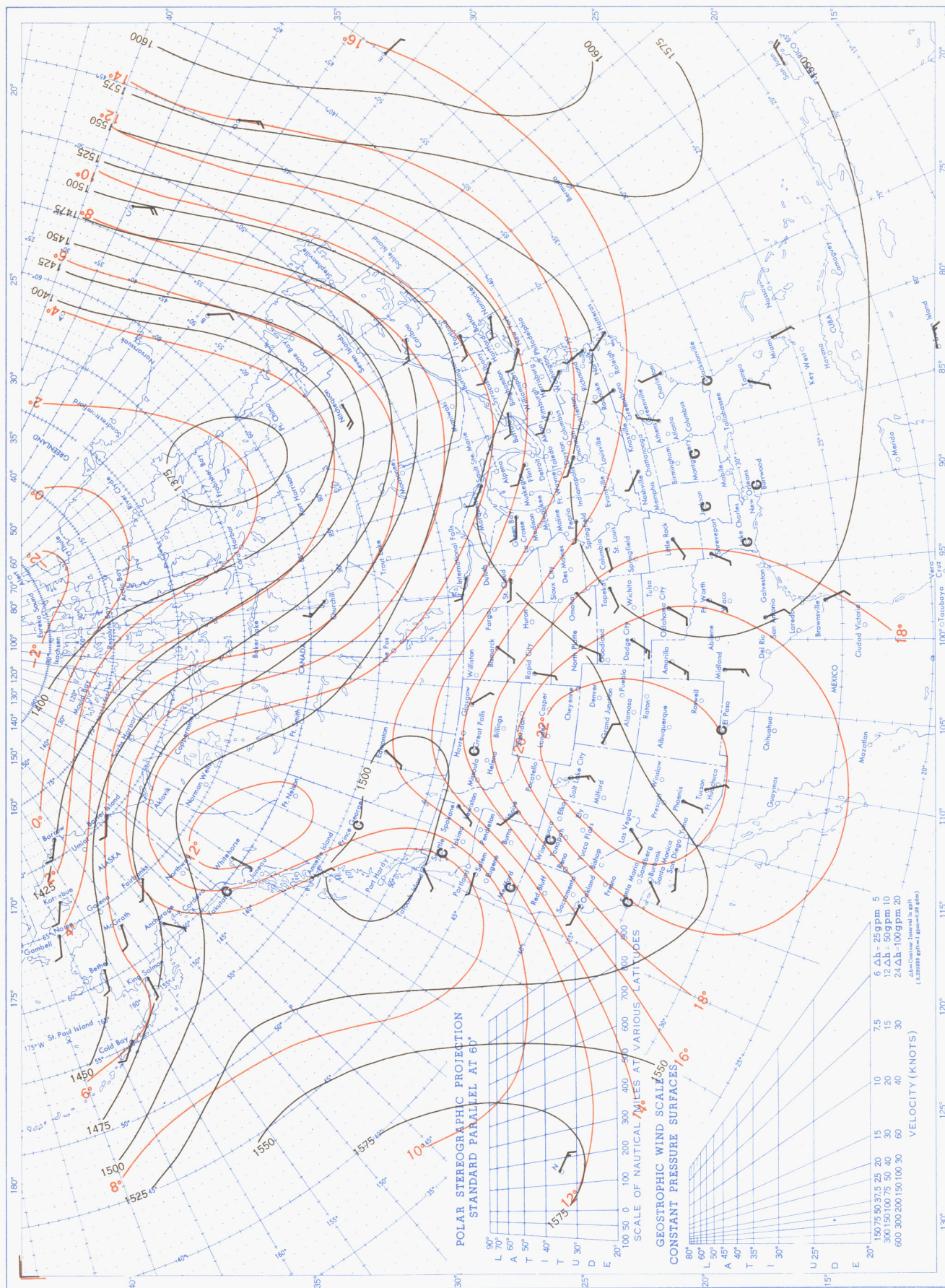
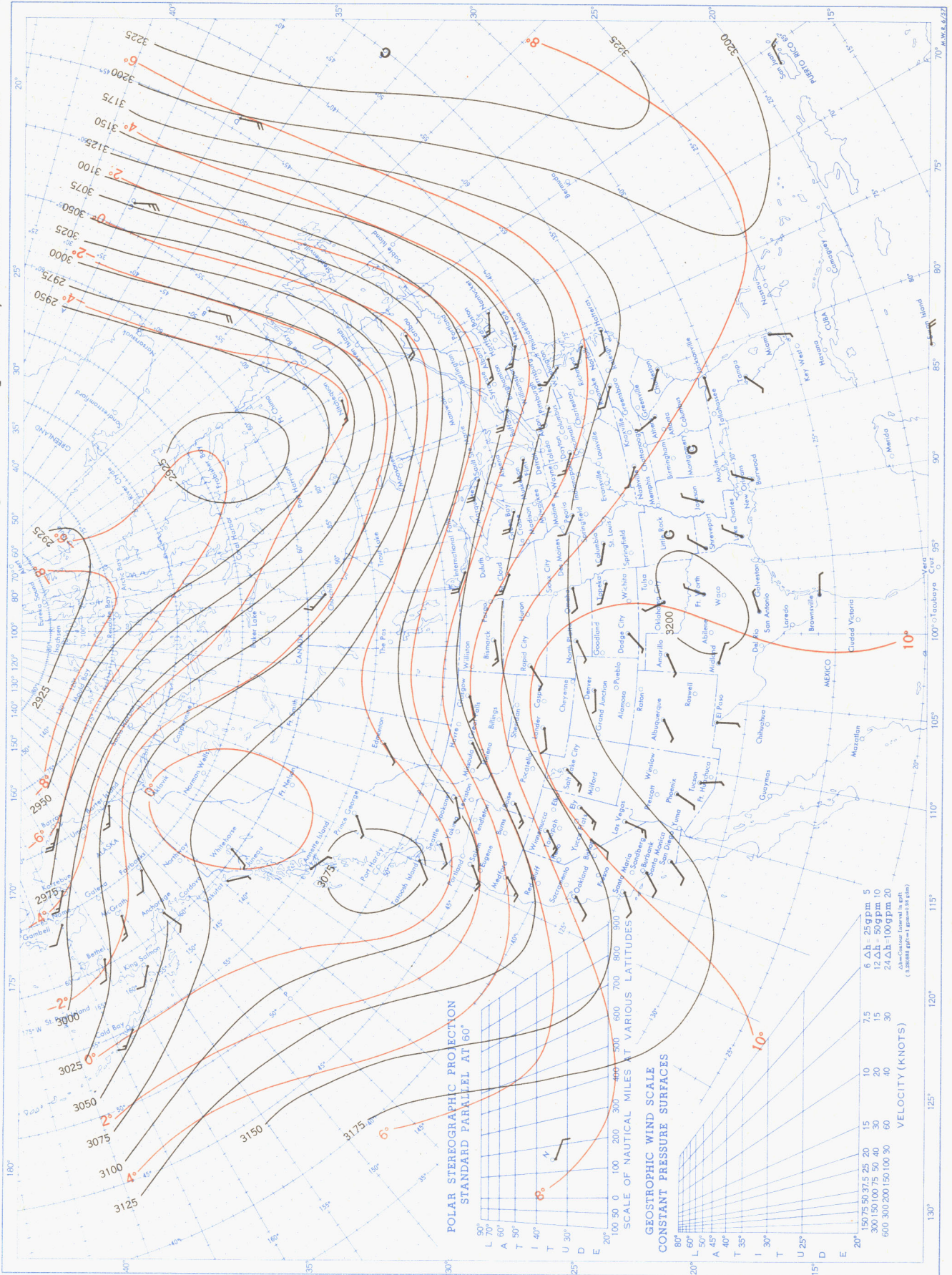




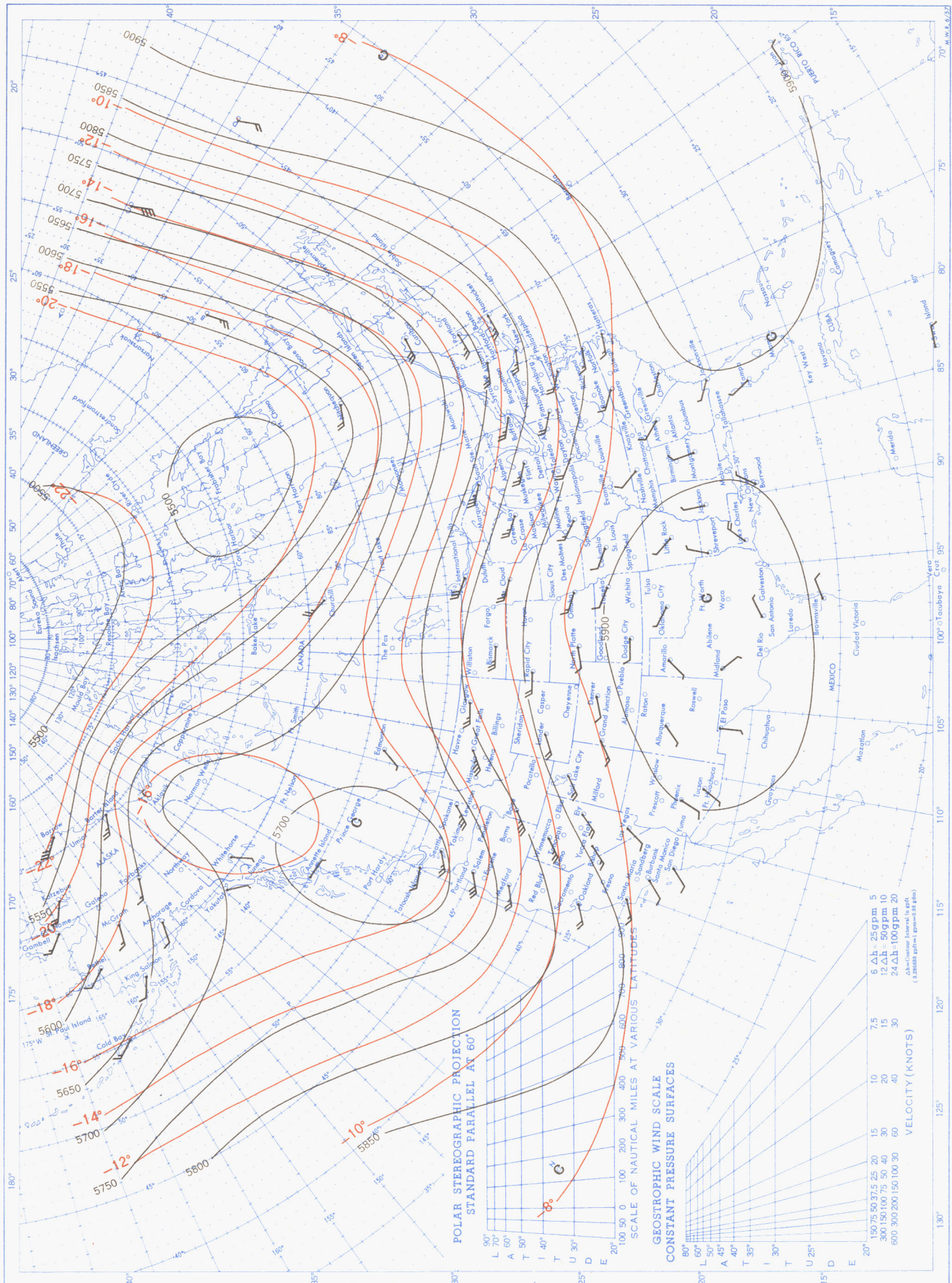
Chart XIII. 700-mb. Surface, 1200 GMT, August 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map.



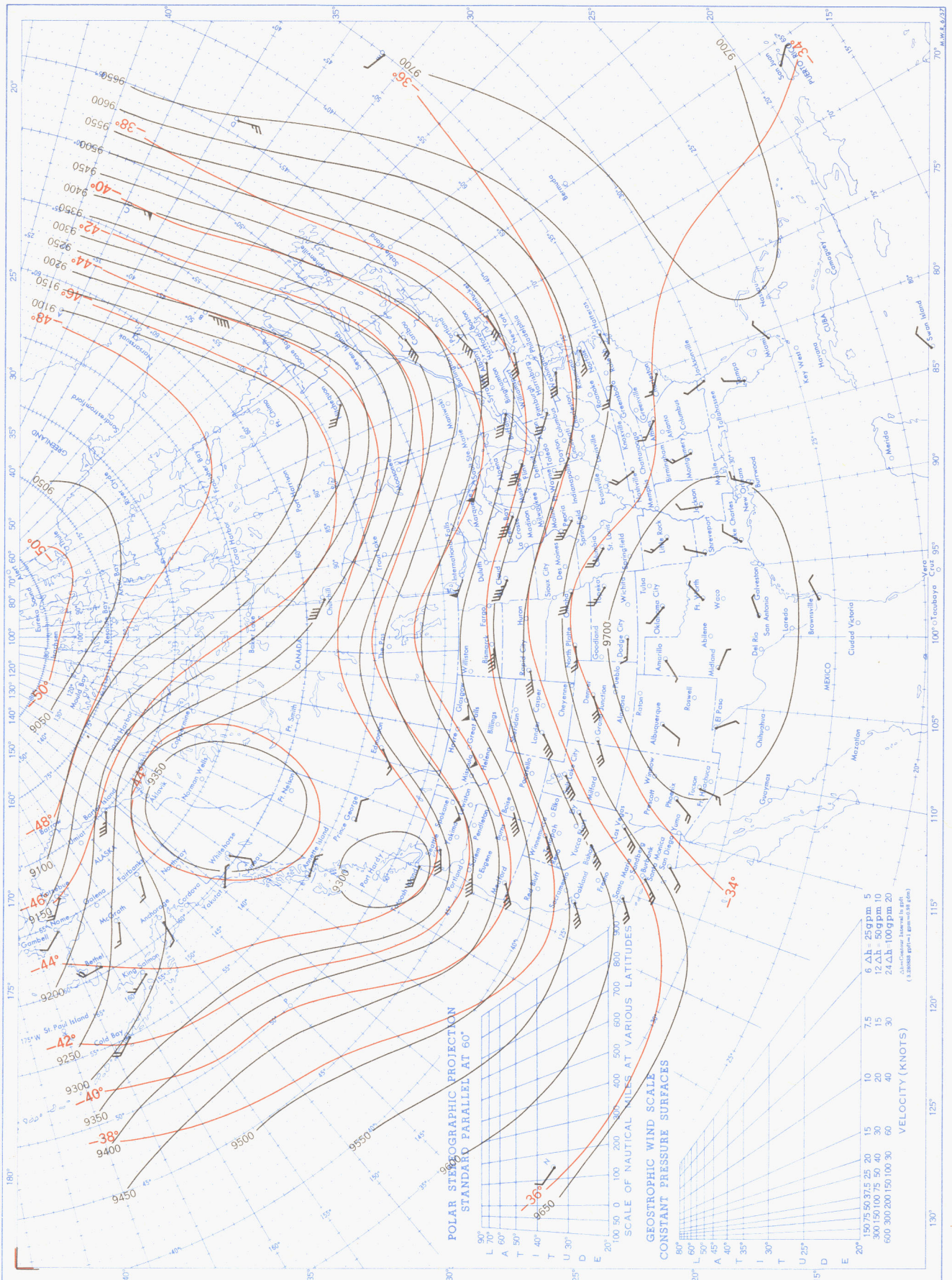
Chart XIV. 500-mb. Surface, 1200 GMT, August 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map.



Chart XV. 300-mb. Surface, 1200 GMT, August 1957. Average Height and Temperature, and Resultant Winds.



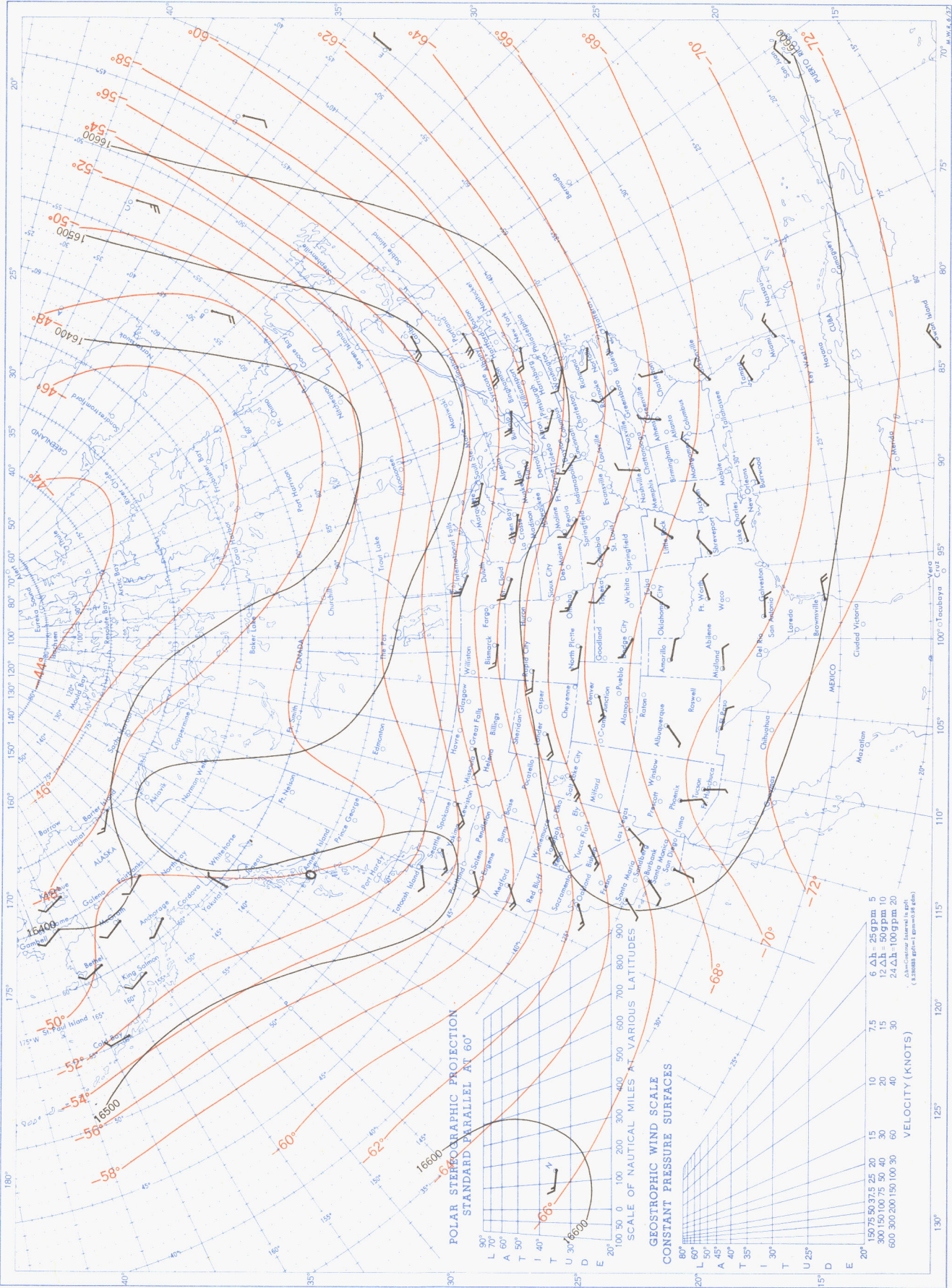
See Chart XII for explanation of map.







Chart XVII. 100-mb. Surface, 1200 GMT, August 1957. Average Height and Temperature, and Resultant Winds.



See Chart XII for explanation of map.